PATENT ABSTRACTS OF JAPAN

(11)Publication number : 10-285229
(43)Date of publication of application : 23.10.1998

(51)Int.Cl. H04L 27/20

(21)Application number : 09-100996
(22)Date of filing : 03.04.1997

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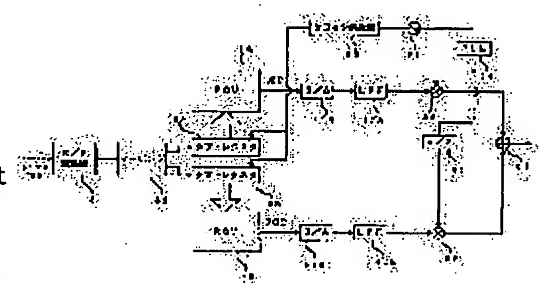
(54) TRANSMITTER ADOPTING PI/4 SHIFT QPSK

(57)Abstract:
PROBLEM TO BE SOLVED: To reduce the capacity of a memory of the transmitter that adopts the p/4 shift QPSK, calculates a waveform of data after passing through a Nyquist filter in advance and stores it in the memory.
SOLUTION: Assignment of data with respect to a symbol is conducted similarly to the case with a symbol of the 4-phase QPSK, and a mapping circuit 32 provides an output of position information of any of four symbols. The position information of transited symbols is latched in shift registers 6A, 6B and waveform data (I and Q components) in response to the information are read from ROMs 7A, 7B. The communication by the p/4 QPSK is conducted by increasing/decreasing the frequency of a carrier modulated by the I and Q components by fs/8 (fs is a symbol rate) with respect to a frequency fc of the carrier at demodulation. Since number of symbols used by the transmitter is 4, no many addresses of the ROMs are required and the required memory capacity is reduced.



LEGAL STATUS
[Date of request for examination]
[Date of sending the examiner's decision of rejection]
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
[Date of final disposal for application]
[Patent number]
[Date of registration]
[Number of appeal against examiner's decision of rejection]
[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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CLAIMS

[Claim(s)]
[Claim 1] While being located in the equal distance from a coordinate core on a Gauss-Argand plane and defining four symbols whose mutual phase contrast of an adjacent symbol is pi/2 Divide at a time 2 bits of binary-ized signal trains which are data which should be transmitted, and four kinds of data decided by these 2 bits are assigned to said four symbols, respectively. The signal-processing section which outputs the positional information of the symbol corresponding to the 2-bit data concerned as a digital signal, The shift register memorized while the array of the positional information of the symbol which the positional information of the symbol from this signal-processing section is incorporated one by one, and is observing to predetermined timing, and the symbol before and behind that shifts, While the in-phase component and orthogonal component of a data point by which it was beforehand calculated after letting the filter of a predetermined property in case a symbol changes pass match with transition of a symbol and are stored The digital signal corresponding to the array of the positional information of the symbol memorized by the shift register concerned outputted from said shift register is made into the address. If fc and SHIMBORURE-TO are set to fs, the frequency of the memory from which the in-phase component and orthogonal component of said data point are read, and the subcarrier for a recovery The subcarrier output section which a frequency is fc**fs/8 and outputs the 1st and 2nd subcarriers from which pi/2 phase is shifted mutually, The 1st and the 2nd amplitude modulation section which carry out amplitude modulation of said 1st and 2nd subcarriers, respectively with the analog signal according to the in-phase component and orthogonal component which are read from said memory, The sending set of pi / 4 shift QPSK characterized by having the synthetic section which compounds the modulation output from these [1st] and the 2nd amplitude modulation section, and outputs a synthetic wave.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] In the sending set of pi / 4 shift QPSK, this invention calculates beforehand the data point after letting a filter in case a symbol changes (for example, Nyquist characteristics) pass, stores it in memory, and relates to the technical field which transmits by reading the data point according to the array of transition of a symbol from memory.
[0002]
[Description of the Prior Art] There is QPSK (Quadrature Phase Shift Keying) as one of the modulation techniques in digital mobile communication. Although it is located in the equal distance from a coordinate core and this adjoins each other on a Gauss-Argand plane as shown in drawing 4 , it can take four symbols (signal point) whose mutual phase contrast is pi/2, and is assigning 2 bit data to each symbol. There is a method which considers as the technique which advanced QPSK further 1 step, and is called pi / 4 shift QPSK, and by this method, as shown in drawing 5 , whenever it chooses one symbol corresponding to data, only pi/4 is rotated for each symbol on a Gauss-Argand plane, and phase contrast between symbols is made into **45 degrees and **135 degrees. In addition, O mark in drawing 5 and x mark show the symbol before and behind rotation, respectively, and show signs that it moves to the symbol to which the following data were assigned from the symbol to which (11) was assigned.
[0003] By the way, in this kind of communication mode, while removing interference between symbols, in order to add reservation of occupancy bandwidth, and a limit of contiguity (or degree contiguity) leakage power, it is required to use the filter of Nyquist characteristics. And when a low power is required like especially PDC (Personal Digital Cellular) and PHS (Personal Handy Phone System), or in order to treat high speed data like PHS, when DSP (Digital Signal Processor) is not of use for count The wave after letting a nyquist filter pass is calculated beforehand, without using DSP. The digital value of the result was memorized to ROM (Read Only Memory), and the method which outputs the output of the ROM through a D/A (Digital/Analog) converter one by one is adopted.
[0004] The response wave of data and a nyquist filter and sending-circuit configuration which were stored in ROM are explained below. Drawing 6 shows the response wave of a nyquist filter, and in order to give explanation intelligible, even if it compounds a wave only within two symbols, it shows signs (there is no intersymbol interference) that a symbol does not change. However, since it has the response characteristic of infinity length theoretically, in order to add a limit to the response time, a nyquist filter must hang a window function and must close count. Since the die length of a window has a bad influence on short ** past **, contiguity leakage power, and a symbol point, count is closed as past of symbol observed, for example 5 symbol, and a total of 11 symbols of five subsequent symbols.
[0005] In the Gauss-Argand plane shown in drawing 7 here, the case where 2 bit data which should be transmitted move to E points from a symbol D point is considered. The data which should be stored in ROM are the migration locus of the data of E points from D point in drawing 7 , and are eight data (interpolation data) corresponding to the wave of minute spacing specifically divided by ** mark between D point and E points. Before this migration locus is not decided only

by D point and E points and passes along D point, it changes by whether the symbol of ****** was passed, and which symbol is passed after passing along E points. Although the example of drawing shows the case of migration of A point ->D point ->E point ->H point, if the symbol in front of [of D point] one is except an A point, for example, a migration locus will also change.
[0006] Therefore, D point -> theoretically, although the response wave of the migration locus to E points, i.e., a nyquist filter, cannot be expressed that all the symbols of the past and the future are not taken into consideration, it adds a limit to the response time like previous statement in fact, and is giving it to ROM rather than E points by using the response wave corresponding to a total of 11 symbols in front of 5 symbols and after 5 symbols as data. The interpolation data between D point and E points correspond to the data point of the minute section divided by ** mark on a synthetic wave in drawing 6 .
[0007] If the relation between passage of the symbol of data which should transmit, and read-out of the data in ROM (wave-like locus data) is shown in drawing 8 , this example shows the situation of read-out of the wave-like locus data of ROM in the case of the data which should be transmitted moving with B->C->G->A->D->E->H->B->E->F->G, and moving to D->E located in the center of that transition. One in drawing 8 is a shift register, and a corresponding symbol (if it says correctly positional information of a symbol) is sent one by one with migration between symbols. The number of the symbols on a par with this shift register 1 is 11, and the address when reading the wave-like locus data at the time of migration to E points from the inside of ROM2 is equivalent to the combination of the symbol on a par with a shift register 1 from D point currently noted in migration of the above-mentioned symbol.
[0008] Although the transmissions itself are four values in 1 / 4pi shift QPSK, since arrangement of a symbol is eight phases seemingly, the number of bits for pinpointing the location of a symbol is the triplet need, therefore the number of bits of the address is set to x(number on a par with shift register 1) (number of bits which pinpoints location of symbol) =11x3. While the list of the symbol which the following symbol was incorporated and was memorized to predetermined timing until now moves to a shift register 1 The symbol in front of the oldest symbol, i.e., 4 symbols of E points, is extruded, and it disappears. In this way, it becomes the appearance by which the limit was added to the response time of a nyquist filter, and the wave-like locus data applied to migration to E points from D point currently noted in the time list of 11 symbols will be read from ROM in this example. The wave-like locus data in ROM which starts migration to E points from this D point are interpolation data of previous statement between D point on a response wave, and E points.
[0009] If the situation of storing of the data in ROM is shown in drawing 9 , according to the address which is the contents of the shift register, the data which specify the migration locus corresponding to migration of the symbol to observe, for example, eight interpolation data, are stored. That is, if an exaggerated sampling is performed 8 times in this case and the address is outputted from a shift register, while eight data corresponding to this address will be read one by one by the exaggerated sampling clock, and will be sent to a D/A converter like the after-mentioned and the positional information of the following symbol will go into a shift register after 8 clocks, the positional information of the symbol in front of 5 symbols of the symbol currently observed is extruded, and it disappears. The interpolation data in ROM are the in-phase component (I component) and orthogonal component (Q component) which specify a wave in fact.
[0010] When the whole sending-circuit configuration using such a ROM filter is shown in drawing 10 , 3 is a serial/parallel-conversion machine for dividing into 2 bits at a time the serial signal (binary-ized signal train after quantization) according to the data, for example, the sound signal, which should be transmitted, and outputting the 2-bit parallel signal. It assigns whether 3 is equivalent to which symbol of the symbols which are differential mapping circuits and said 2-bit parallel signal shows to drawing 5 . In pi / 4 shift QPSK, since arrangement of a symbol is eight phases seemingly like previous statement, the positional information which pinpoints the location of a symbol is sent to the 1st and 2nd shift registers 1A and 1B from the differential mapping circuit 31 as symbol data of a triplet.
[0011] In shift registers 1A and 1B, as already explained, the positional information of a symbol is

incorporated one by one to predetermined timing, for example, the bit signal corresponding to a list and its list in 11 symbols is outputted to 1st and 2nd ROM2A and 2B as the address. From these ROM2A and 2B, I component and Q component of a data point corresponding to transition of the symbol to observe are outputted, I component is sent to 1st amplitude modulator 5A through 1st D/A-converter41A and 1st low pass filter (LPF) 42A, and Q component is sent to 2nd amplitude modulator 5B through 2nd D/A-converter41B and 2nd low pass filter 42B.
[0012] The subcarrier from an oscillator 51 which operates based on the clock outputted from the clock generation machine 50 on the other hand is inputted into 1st amplitude modulator 5A as it is, and amplitude modulation is carried out by I component from low pass filter 42A. Moreover, the phase shift of said subcarrier is carried out only pi/2 with pi/2 phase shifter 52, it is inputted into 2nd amplitude modulator 5B, and amplitude modulation is carried out by Q component from low pass filter 42B. The output of amplitude modulators 5A and 5B is compounded in the synthetic circuit 53, and is transmitted from the antenna which the synthetic wave does not illustrate.
[0013]
[Problem(s) to be Solved by the Invention] By the way, since the positional information of a symbol is a triplet when it is 11 symbols like previous statement of the die length of the window to the response wave of a nyquist filter, ROM according to the address which is 11x3=33 bit is needed, the storage capacity of ROM becomes huge, equipment is enlarged, and cost also has the problem of being high.
[0014] This invention aims at lessening memory space in the sending set which calculates the wave after letting a nyquist filter pass beforehand using pi / 4 shift QPSK, and stores the result in memory.
[0015]
[Means for Solving the Problem] While this invention defines four symbols whose mutual phase contrast of the symbol which is located in the equal distance and adjoins it is pi/2 from a coordinate core on a Gauss-Argand plane in the sending set of pi / 4 shift QPSK Divide at a time 2 bits of binary-ized signal trains which are data which should be transmitted, and four kinds of data decided by these 2 bits are assigned to said four symbols, respectively. The signal-processing section which outputs the positional information of the symbol corresponding to the 2-bit data concerned as a digital signal, The shift register memorized while the array of the positional information of the symbol which the positional information of the symbol from this signal-processing section is incorporated one by one, and is observing to predetermined timing, and the symbol before and behind that shifts, While the in-phase component and orthogonal component of a data point by which it was beforehand calculated after letting the filter of a predetermined property in case a symbol changes pass match with transition of a symbol and are stored The digital signal corresponding to the array of the positional information of the symbol memorized by the shift register concerned outputted from said shift register is made into the address. If fc and SHIMBORURE-TO are set to fs, the frequency of the memory from which the in-phase component and orthogonal component of said data point are read, and the subcarrier for a recovery The subcarrier output section which a frequency is fc**fs/8 and outputs the 1st and 2nd subcarriers from which pi/2 phase is shifted mutually, The 1st and the 2nd amplitude modulation section which carry out amplitude modulation of said 1st and 2nd subcarriers, respectively with the analog signal according to the in-phase component and orthogonal component which are read from said memory, It is characterized by having the synthetic section which compounds the modulation output from these [1st] and the 2nd amplitude modulation section, and outputs a synthetic wave.
[0016] The array of the positional information of the symbol which is memorized by the shift register here and which is observed and the symbol before and behind that is the semantics of the list of transition of the positional information of a symbol including the future symbol after passing the past symbol and past Symbol P which will have changed by the time it results in this symbol, when it is going to output the wave corresponding to a certain symbol P.
[0017]
[Embodiment of the Invention] Before explaining the configuration of the sending set of the gestalt

of operation of this invention, drawing 1 is used and explained about the outline of the gestalt of this operation. The phase of what eight symbols (signal point) shown by A1 - A4, and B1 - B4 in a Gauss-Argand plane adjoin has shifted by a unit of 45 degrees, and if it is conventional pi / 4 shift QPSK, the group of A1 - A4 and the group of B1 - B4 will be set as the object of the data assignment (mapping) to alternation to the timing according to a symbol rate.
[0018] The gestalt of this operation realizes the communication mode of pi / 4 shift QPSK, using only the positional information of four symbols which use the place which needed eight positional information with the 4 phase QPSK, since pi / 4 shift QPSK needs eight symbols seemingly, by this, is going to reduce the number of the addresses of ROM and is going to suppress increase of memory space.
[0019] Although the symbol corresponding to data if it is conventional pi / 4 shift QPSK when data change to (11) from (10) now, supposing the subcarrier is turning counterclockwise in drawing 1 changes to B-2 from A4, it is made to change to A1 seemingly from A4 in this example, i.e., data (11) are mapped as A1 and the positional information of A1 is outputted to a shift register. However, the way things stand, since it is the same as the conventional 4 phase QPSK, a subcarrier is brought forward only for pi / 4 minutes. It is the semantics of bringing forward to the subcarrier when getting over bringing a subcarrier forward with a receiving set, and if the frequency of the subcarrier at the time of a recovery is set to fc and a symbol rate is set to fs, the carrier frequency used with a sending set will serve as a value (fc+fs/8) which added fs/8 to fc.
[0020] Since transition to A1 from A4 requires only the time amount (1/fs) of transition for one symbol, it becomes the same as having changed to B-2 from A4 and the communication link having been performed by bringing fc forward like **** according to this time amount. The data point corresponding to transition of this symbol stored in ROM is interpolation data between A1 and A4.
[0021] Although this example explains as that by which data move in the counterclockwise direction in the Gauss-Argand plane, it becomes the same as in the case of right-handed rotation, having assigned A1 to the degree of A4, having changed to B1 from A4 by delaying a subcarrier only for pi / 4 minutes, and the communication link having been performed. That is, the frequency of the subcarrier used with a sending set in this case is set to fc-fs/8. Thus, this invention assigns a symbol like the 4 phase QPSK, and the description is in the point that only fs/8 shifted carrier frequency to fc.
[0022] Next, it explains, referring to drawing 2 about the circuitry for realizing such technique. The same sign is shown about the same part as drawing 10 . The serial signal according to the data which should be transmitted is changed into a 2-bit parallel signal by the serial/parallel-conversion machine 3, and the positional information of a symbol is outputted from the mapping circuit 32 according to this parallel signal. Since mapping (assign a parallel signal to a symbol and output the positional information) performed here is the same as that of the 4 phase QPSK, differential mapping which was being performed in pi / 4 shift QPSK is omitted.
[0023] Although the positional information of the assigned symbol is outputted from the mapping circuit 32, since the number of symbols is four, this positional information is a signal which is 2 bits, and the positional information of 11 symbols which contain every five symbols before and after the symbol (symbol to observe) which this 2-bit positional information is incorporated one by one by the 1st and 2nd shift registers 6A and 6B, for example, is going to transmit is memorized.
[0024] In 1st and 2nd ROM7A and 7B, the response data point of the nyquist filter corresponding to transition of 11 symbols which contain every five symbols approximately [the] is stored about the symbol which is going to transmit as the term of the conventional technique described. This data point is the same as the data in ROM2A which specifies the migration locus of data which connects the shift register which it is going to transmit, for example, and the symbol in front of one of them and which is eight interpolation data calculated beforehand, for example, and is shown in drawing 9 , and 2B, the data of I component are stored in 1st ROM7A, and the data of Q component are stored in 2nd ROM7B, respectively. However, although the number of the address lines from shift register 1A (1B) in drawing 10 was 3x11, in this example, since the positional

information of a symbol is specified by 2 bits, the number of the address lines from shift register 6A (6B) is 2x11, and the number of bits of the address of the data in ROM7A (7B) is set to 2x11.
[0025] In shift registers 6A and 6B, while the positional information of the newest symbol is incorporated with the clock from the clock generation machine 50, the positional information of the oldest symbol is thrown away, and I component and Q component of a data point are read from ROMs 7A and 7B by making the array of the positional information of 11 symbols into the address, respectively. Said clock specifies the symbol rate fs and the pulse separation of a clock are 1-/fs seconds. If the address is given to ROM7A (7B), eight interpolation data will be read one by one by the exaggerated sampling clock, and it will be inputted into amplitude modulator 5A (5B) through D/A-converter41A (41B) and low pass filter 42A (42B).
[0026] As for the subcarrier outputted from an oscillator 51 on the other hand, only fs/4 are brought forward by the phase locked loop (PLL) circuit 54. That is, it considers as the frequency of fc+fs/4. In addition, this fc is the carrier frequency of transmission as stated above, and is also a frequency when getting over with a receiving set. In the 1st and 2nd amplitude modulators 5A and 5B, they are cos {2pi(fc+fs/8) t} and sin{2pi (the subcarrier of fc+fs/8} is inputted, I component and Q component which are outputted from low pass filters 42A and 42B become irregular, respectively, and the modulation output is compounded in the synthetic section 53.). In this case, a symbol is left-handed rotation in drawing 1 , and by the memory by the side of a receiving set, it has shifted the correspondence relation between the position coordinate of a symbol, and the data assigned to a symbol so that it may become left-handed rotation.
[0027] When transition of the symbol of drawing 7 mentioned as an example by the term of the conventional technique here is applied to this example, it comes to be shown in drawing 3 . That is, when data change with (10) ->(01) ->(11) -> (00), as shown in a dotted line, with the conventional sending set, it is mapped with A4->B3 ->A2 ->B1, but in this example, the symbol assigned in the mapping circuit 32 serves as A4->A2 ->A2 ->A4, as the chain line shows. In a receiving side, the data of (10) ->(01) ->(11) -> (00) get over by using the receiving set of conventional pi / 4 shift QPSK as it is.
[0028] As mentioned above, according to the gestalt of this operation, the communication link by pi / 4 shift QPSK is realizable, since data are moreover transmitted as four symbols, the positional information of a symbol becomes 2 bits, and the address incorporated by 11 pieces, then ROMs 7A and 7B like **** in the number of the symbols memorized to a shift register becomes 11x2 bits. Therefore, since the one number of bits of the address becomes fewer compared with the case where data are transmitted, as eight symbols, the required memory space to ROMs 7A and 7B serves as half.
[0029]
[Effect of the Invention] According to this invention, memory space can be lessened in the sending set which calculates the wave after letting a nyquist filter pass beforehand using pi / 4 shift QPSK, and stores the result in memory.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] By the way, since the positional information of a symbol is a triplet when it is 11 symbols like previous statement of the die length of the window to the response wave of a nyquist filter, ROM according to the address which is 11x3=33 bit is needed, the storage capacity of ROM becomes huge, equipment is enlarged, and cost also has the problem of being high.
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MEANS

[Means for Solving the Problem] While this invention defines four symbols whose mutual phase contrast of the symbol which is located in the equal distance and adjoins it is pi/2 from a coordinate core on a Gauss-Argand plane in the sending set of pi / 4 shift QPSK Divide at a time 2 bits of binary-ized signal trains which are data which should be transmitted, and four kinds of data decided by these 2 bits are assigned to said four symbols, respectively. The signal-processing section which outputs the positional information of the symbol corresponding to the 2-bit data concerned as a digital signal, The shift register memorized while the array of the positional information of the symbol which the positional information of the symbol from this signal-processing section is incorporated one by one, and is observing to predetermined timing, and the symbol before and behind that shifts, While the in-phase component and orthogonal component of a data point by which it was beforehand calculated after letting the filter of a predetermined property in case a symbol changes pass match with transition of a symbol and are stored The digital signal corresponding to the array of the positional information of the symbol memorized by the shift register concerned outputted from said shift register is made into the address. If fc and SHIMBORURE-TO are set to fs, the frequency of the memory from which the in-phase component and orthogonal component of said data point are read, and the subcarrier for a recovery The subcarrier output section which a frequency is fc**fs/8 and outputs the 1st and 2nd subcarriers from which pi/2 phase is shifted mutually, The 1st and the 2nd amplitude modulation section which carry out amplitude modulation of said 1st and 2nd subcarriers, respectively with the analog signal according to the in-phase component and orthogonal component which are read from said memory, It is characterized by having the synthetic section which compounds the modulation output from these [1st] and the 2nd amplitude modulation section, and outputs a synthetic wave.
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change to (11) from (10) now, supposing the subcarrier is turning counterclockwise in drawing 1 changes to B-2 from A4, it is made to change to A1 seemingly from A4 in this example, i.e., data (11) are mapped as A1 and the positional information of A1 is outputted to a shift register. However, the way things stand, since it is the same as the conventional 4 phase QPSK, a subcarrier is brought forward only for pi / 4 minutes. It is the semantics of bringing forward to the subcarrier when getting over bringing a subcarrier forward with a receiving set, and if the frequency of the subcarrier at the time of a recovery is set to fc and a symbol rate is set to fs, the carrier frequency used with a sending set will serve as a value (fc+fs/8) which added fs/8 to fc.

[0020] Since transition to A1 from A4 requires only the time amount (1/fs) of transition for one symbol, it becomes the same as having changed to B-2 from A4 and the communication link having been performed by bringing fc forward like **** according to this time amount. The data point corresponding to transition of this symbol stored in ROM is interpolation data between A1 and A4.

[0021] Although this example explains as that by which data move in the counterclockwise direction in the Gauss-Argand plane, it becomes the same as in the case of right-handed rotation, having assigned A1 to the degree of A4, having changed to B1 from A4 by delaying a subcarrier only for pi / 4 minutes, and the communication link having been performed. That is, the frequency of the subcarrier used with a sending set in this case is set to fc-fs/8. Thus, this invention assigns a symbol like the 4 phase QPSK, and the description is in the point that only fs/8 shifted carrier frequency to fc.

[0022] Next, it explains, referring to drawing 2 about the circuitry for realizing such technique. The same sign is shown about the same part as drawing 10 . The serial signal according to the data which should be transmitted is changed into a 2-bit parallel signal by the serial/parallel-conversion machine 3, and the positional information of a symbol is outputted from the mapping circuit 32 according to this parallel signal. Since mapping (assign a parallel signal to a symbol and output the positional information) performed here is the same as that of the 4 phase QPSK, differential mapping which was being performed in pi / 4 shift QPSK is omitted.

[0023] Although the positional information of the assigned symbol is outputted from the mapping circuit 32, since the number of symbols is four, this positional information is a signal which is 2 bits, and the positional information of 11 symbols which contain every five symbols before and after the symbol (symbol to observe) which this 2-bit positional information is incorporated one by one by the 1st and 2nd shift registers 6A and 6B, for example, is going to transmit is memorized.

[0024] In 1st and 2nd ROM7A and 7B, the response data point of the nyquist filter corresponding to transition of 11 symbols which contain every five symbols approximately [the] is stored about the symbol which is going to transmit as the term of the conventional technique described. This data point is the same as the data in ROM2A which specifies the migration locus of data which connects the shift register which it is going to transmit, for example, and the symbol in front of one of them and which is eight interpolation data calculated beforehand, for example, and is shown in drawing 9 , and 2B, the data of I component are stored in 1st ROM7A, and the data of Q component are stored in 2nd ROM7B, respectively. However, although the number of the address lines from shift register 1A (1B) in drawing 10 was 3x11, in this example, since the positional information of a symbol is specified by 2 bits, the number of the address lines from shift register 6A (6B) is 2x11, and the number of bits of the address of the data in ROM7A (7B) is set to 2x11.

[0025] In shift registers 6A and 6B, while the positional information of the newest symbol is incorporated with the clock from the clock generation machine 50, the positional information of the oldest symbol is thrown away, and I component and Q component of a data point are read from ROMs 7A and 7B by making the array of the positional information of 11 symbols into the address, respectively. Said clock specifies the symbol rate fs and the pulse separation of a clock are 1-/fs seconds. If the address is given to ROM7A (7B), eight interpolation data will be read one by one by the exaggerated sampling clock, and it will be inputted into amplitude modulator 5A (5B) through D/A-converter41A (41B) and low pass filter 42A (42B).

[0026] As for the subcarrier outputted from an oscillator 51 on the other hand, only fs/4 are

brought forward by the phase locked loop (PLL) circuit 54. That is, it considers as the frequency of fc+fs/4. In addition, this fc is the carrier frequency of transmission as stated above, and is also a frequency when getting over with a receiving set. In the 1st and 2nd amplitude modulators 5A and 5B, they are cos {2pi(fc+fs/8) t} and sin{2pi (the subcarrier of fc+fs/8} is inputted, I component and Q component which are outputted from low pass filters 42A and 42B become irregular, respectively, and the modulation output is compounded in the synthetic section 53.). In this case, a symbol is left-handed rotation in drawing 1 , and by the memory by the side of a receiving set, it has shifted the correspondence relation between the position coordinate of a symbol, and the data assigned to a symbol so that it may become left-handed rotation.

[0027] When transition of the symbol of drawing 7 mentioned as an example by the term of the conventional technique here is applied to this example, it comes to be shown in drawing 3 . That is, when data change with (10) ->(01) ->(11) -> (00), as shown in a dotted line, with the conventional sending set, it is mapped with A4->B3 ->A2 ->B1, but in this example, the symbol assigned in the mapping circuit 32 serves as A4->A2 ->A2 ->A4, as the chain line shows. In a receiving side, the data of (10) ->(01) ->(11) -> (00) get over by using the receiving set of conventional pi / 4 shift QPSK as it is.

[0028] As mentioned above, according to the gestalt of this operation, the communication link by pi / 4 shift QPSK is realizable, since data are moreover transmitted as four symbols, the positional information of a symbol becomes 2 bits, and the address incorporated by 11 pieces, then ROMs 7A and 7B like **** in the number of the symbols memorized to a shift register becomes 11x2 bits. Therefore, since the one number of bits of the address becomes fewer compared with the case where data are transmitted, as eight symbols, the required memory space to ROMs 7A and 7B serves as half.

[Translation done.]

JAPANESE [JP,10-285229,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

(19)日本国特許庁（ＪＰ）　(12) **公開特許公報**（Ａ）　(11)特許出願公開番号

特開平10－285229

(43)公開日　平成10年(1998)10月23日

(51)Int.Cl.^{6}	識別記号	ＦＩ	
Ｈ０４Ｌ　27/20		Ｈ０４Ｌ　27/20	Ａ

審査請求　未請求　請求項の数１　ＦＤ　（全８頁）

(21)出願番号　特願平9－100996

(22)出願日　平成９年(1997)４月３日

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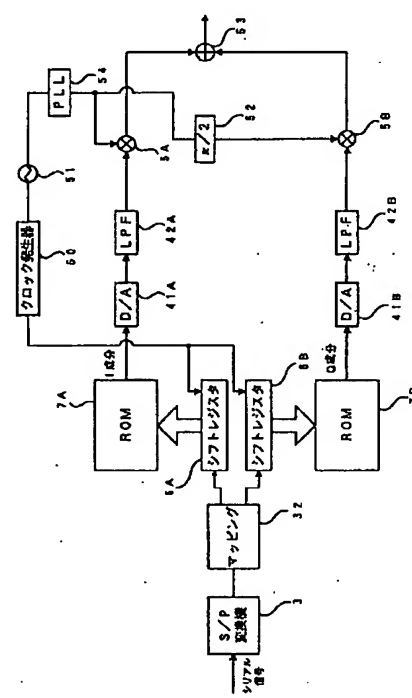
(54)【発明の名称】　π／４シフトＱＰＳＫの送信装置

(57)【要約】

【課題】　π／４シフトＱＰＳＫを用い、ナイキストフィルタを通した後の波形を予め計算してメモリに格納する送信装置において、メモリ容量を少なくする。

【解決手段】　シンボルに対するデータの割り当てを４相ＱＰＳＫのシンボルと同様に行い、マッピング回路３２では４つのシンボルのいずれかのシンボルの位置情報が出力される。シフトレジスタ６Ａ、６Ｂには、推移するシンボルの位置情報が配列され、この配列に応じた波形データ（Ｉ成分及びＱ成分）がＲＯＭ７Ａ、７Ｂから読み出される。これらＩ成分及びＱ成分により変調される搬送波を、復調時の搬送波の周波数ｆｃに対してｆｓ／８（ｆｓはシンボルレート）だけ増減することにより、π／４ＱＰＳＫの通信が行われ、しかも送信装置で用いるシンボルは４個なので、ＲＯＭのアドレスが少なくなり、必要なメモリ容量を低減できる。



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【特許請求の範囲】

【請求項１】　複素平面上で座標中心から等距離に位置し、隣り合うシンボルの互いの位相差がπ／２である４個のシンボルを定めると共に、送信すべきデータである２値化信号列を２ビットづつ分け、この２ビットで決まる４通りのデータを前記４個のシンボルに夫々割り当てて、当該２ビットのデータに対応するシンボルの位置情報をディジタル信号として出力する信号処理部と、

この信号処理部からのシンボルの位置情報が所定のタイミングで順次取り込まれ、注目しているシンボル及びその前後のシンボルの位置情報の配列がシフトしながら記憶されるシフトレジスタと、

シンボルが推移するときの所定の特性のフィルタを通した後の予め計算された波形データの同相成分及び直交成分がシンボルの推移と対応づけて格納されると共に、前記シフトレジスタから出力される、当該シフトレジスタに記憶されたシンボルの位置情報の配列に対応するディジタル信号をアドレスとして、前記波形データの同相成分及び直交成分が読み出されるメモリと、

復調用の搬送波の周波数をｆｃ、シンボルレートをｆｓとすると、周波数がｆｃ±ｆｓ／８であって、互いにπ／２位相がずれている第１及び第２の搬送波を出力する搬送波出力部と、

前記メモリから読み出される同相成分及び直交成分に応じたアナログ信号により前記第１及び第２の搬送波を夫々振幅変調する第１及び第２の振幅変調部と、

これら第１及び第２の振幅変調部からの変調出力を合成して合成波を出力する合成部と、を備えたことを特徴とするπ／４シフトＱＰＳＫの送信装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、π／４シフトＱＰＳＫの送信装置において、シンボルが推移するときの例えばナイキスト特性のフィルタを通した後の波形データを予め計算してメモリに格納し、シンボルの推移の配列に応じた波形データをメモリから読み出して送信を行う技術分野に関するものである。

【０００２】

【従来の技術】ディジタル移動通信における変調技術の一つとしてＱＰＳＫ（Ｑｕａｄｒａｔｕｒｅ　Ｐｈａｓｅ　Ｓｈｉｆｔ　Ｋｅｙｉｎｇ）がある。これは図４に示すように複素平面上で座標中心から等距離に位置し、隣り合うものの互いの位相差がπ／２である４つのシンボル（信号点）を取り得るもので、２ビットデータを各シンボルに割り当てている。ＱＰＳＫを更に一歩進めた技術としてπ／４シフトＱＰＳＫと呼ばれる方式があり、この方式では、図５に示すようにデータに対応するシンボルを一つ選択する毎に複素平面上で各シンボルをπ／４だけを回転させ、シンボル間の位相差を±４５°，±１３５°としている。なお図５中○印、×印は夫

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々回転前後のシンボルを示しており、（１１）が割り当てられたシンボルから、次のデータが割り当てられたシンボルに移動する様子を示している。

【０００３】ところでこの種の通信方式においては、シンボル間干渉を取り除くと共に占有帯域幅の確保及び隣接（または次隣接）漏洩電力の制限を加えるためナイキスト特性のフィルタを使用することが必要である。そして特にＰＤＣ（Ｐｅｒｓｏｎａｌ　Ｄｉｇｉｔａｌ　Ｃｅｌｌｕｌａｒ）やＰＨＳ（Ｐｅｒｓｏｎａｌ　Ｈａｎｄｙ　Ｐｈｏｎｅ　Ｓｙｓｔｅｍ）のように低消費電力が要求される場合、あるいはＰＨＳ等のように高速データを扱うためにＤＳＰ（Ｄｉｇｉｔａｌ　Ｓｉｇｎａｌ　Ｐｒｏｃｅｓｓｏｒ）では計算が間に合わない場合には、ＤＳＰを使用せずに、ナイキストフィルタを通した後の波形を予め計算し、その結果のディジタル値をＲＯＭ（Ｒｅａｄ　Ｏｎｌｙ　Ｍｅｍｏｒｙ）に記憶しておき、そのＲＯＭの出力を順次Ｄ／Ａ（Ｄｉｇｉｔａｌ／Ａｎａｌｏｇ）変換器を介して出力する方式を採用している。

【０００４】以下にＲＯＭに格納されたデータ、ナイキストフィルタのレスポンス波形及び送信回路構成に関して説明する。図６はナイキストフィルタのレスポンス波形を示し、説明を分かりやすくするために２つのシンボルに限って波形を合成しても、シンボルが変わらない（符号間干渉がない）様子を示す。しかしながらナイキストフィルタは理論的には無限長の応答特性を持つので応答時間に制限を加えるためにウインドウ関数を掛けて計算を打ち切らなければならない。ウインドウの長さが短か過ぎると隣接漏洩電力およびシンボル点に悪影響を与えるので、例えば注目するシンボルの過去５シンボル及びその後の５シンボルの合計１１シンボルで計算が打ち切られる。

【０００５】ここで図７に示す複素平面において、送信すべき２ビットデータがシンボルＤ点からＥ点に移動する場合について考える。ＲＯＭに格納すべきデータは、図７におけるＤ点からＥ点のデータの移動軌跡であり、具体的にはＤ点とＥ点との間の△印で区切られた微小間隔の波形に対応する８個のデータ（補間データ）である。この移動軌跡は、Ｄ点とＥ点とのみで決まるものではなく、Ｄ点を通る前に過去どのシンボルを通過したか、またＥ点を通った後、どのシンボルを通過するのかによって変わる。図の例ではＡ点→Ｄ点→Ｅ点→Ｈ点の移動の場合を示しているが、例えばＤ点の一つ前のシンボルがＡ点以外であれば移動軌跡も変わってくる。

【０００６】従ってＤ点→Ｅ点への移動軌跡、即ちナイキストフィルタのレスポンス波形は、理論的には過去、未来のシンボル全てを考慮しないと表わすことができないが、実際には既述のように応答時間に制限を加えてＥ点よりも５シンボル前及び５シンボル後の合計１１シンボルに対応するレスポンス波形をデータとしてＲＯＭに

持たせている。Ｄ点とＥ点との間の補間データは、図６においては、合成波形上の△印で区切った微小区間の波形データに対応する。

【０００７】送信すべきデータのシンボルの通過とＲＯＭ内のデータ（波形の軌跡データ）の読み出しとの関係を図８に示すと、この例では送信すべきデータがＢ→Ｃ→Ｇ→Ａ→Ｄ→Ｅ→Ｈ→Ｂ→Ｅ→Ｆ→Ｇと移動し、その推移の中央に位置するＤ→Ｅへ移動する場合のＲＯＭからの波形の軌跡データの読み出しの様子を示している。図８中１はシフトレジスタであり、シンボル間の移動に伴い、対応するシンボル（正確にいえばシンボルの位置情報）が順次送られてくる。このシフトレジスタ１に並ぶシンボルの数は例えば１１個であり、上記のシンボルの移動において、注目しているＤ点からＥ点への移動時の波形の軌跡データをＲＯＭ２内から読み出すときのアドレスが、シフトレジスタ１に並ぶシンボルの組み合わせに相当する。

【０００８】１／４πシフトＱＰＳＫでは伝送そのものは４値であるが、シンボルの配置が見かけ上８相であるため、シンボルの位置を特定するためのビット数は、３ビット必要であり、従ってアドレスのビット数は（シフトレジスタ１に並ぶ数）×（シンボルの位置を特定するビット数）＝１１×３となる。シフトレジスタ１には所定のタイミングで次のシンボルが取り込まれて、今まで記憶されていたシンボルの並びが移動すると共に、最も古いシンボル即ちＥ点の４シンボル前のシンボルが押し出されて消え、こうしてナイキストフィルタの応答時間に制限が加えられた格好になり、この例では１１個のシンボルの時間的並びの中で注目しているＤ点からＥ点への移動に係る波形の軌跡データがＲＯＭから読み出されることになる。このＤ点からＥ点への移動に係るＲＯＭ内の波形の軌跡データとは、レスポンス波形上のＤ点とＥ点との間の既述の補間データである。

【０００９】ＲＯＭ内のデータの格納の様子を図９に示すと、シフトレジスタの内容であるアドレスに応じて、注目するシンボルの移動に対応する移動軌跡を特定するデータ、例えば８個の補間データが格納されている。つまりこの場合８倍オーバサンプリングが行われ、シフトレジスタからアドレスが出力されると、このアドレスに対応する８個のデータがオーバサンプリングクロックにより順次読み出されて後述の如くＤ／Ａ変換器に送られ、８クロック後に次のシンボルの位置情報がシフトレジスタに入ると共に、注目しているシンボルの５シンボル前のシンボルの位置情報が押し出されて消える。実際にはＲＯＭ内の補間データは、波形を特定する同相成分（Ｉ成分）及び直交成分（Ｑ成分）である。

【００１０】このようなＲＯＭフィルタを用いた送信回路の全体構成を図１０に示すと、３は送信すべきデータ例えば音声信号に応じたシリアル信号（量子化後の２値化信号列）を２ビットづつに区切って、その２ビットのパラレル信号を出力するためのシリアル／パラレル変換器である。３は差動マッピング回路であり、前記２ビットのパラレル信号が図５に示すシンボルのうちのどのシンボルに相当するかを割り当てるものである。π／４シフトＱＰＳＫでは既述のようにシンボルの配置が見かけ上８相であるため、シンボルの位置を特定する位置情報は３ビットのシンボルデータとして差動マッピング回路３１から第１及び第２のシフトレジスタ１Ａ、１Ｂに送られる。

【００１１】シフトレジスタ１Ａ、１Ｂでは、既に説明したように所定のタイミングでシンボルの位置情報が順次取り込まれて例えば１１個のシンボルが並び、その並びに対応するビット信号がアドレスとして第１及び第２のＲＯＭ２Ａ、２Ｂに出力される。これらＲＯＭ２Ａ、２Ｂからは、注目するシンボルの遷移に対応する波形データのＩ成分及びＱ成分が出力され、Ｉ成分は第１のＤ／Ａ変換器４１Ａ及び第１のローパスフィルタ（ＬＰＦ）４２Ａを介して第１の振幅変調器５Ａに送られ、Ｑ成分は第２のＤ／Ａ変換器４１Ｂ及び第２のローパスフィルタ４２Ｂを介して第２の振幅変調器５Ｂに送られる。

【００１２】一方クロック発生器５０より出力されるクロックに基づいて動作する発振器５１からの搬送波はそのまま第１の振幅変調器５Ａに入力され、ローパスフィルタ４２ＡからのＩ成分により振幅変調される。また前記搬送波はπ／２移相器５２でπ／２だけ移相されて第２の振幅変調器５Ｂに入力され、ローパスフィルタ４２ＢからのＱ成分により振幅変調される。振幅変調器５Ａ、５Ｂの出力は合成回路５３にて合成され、その合成波が図示しないアンテナから送波される。

【００１３】

【発明が解決しようとする課題】ところでナイキストフィルタのレスポンス波形に対するウインドウの長さを既述のように例えば１１シンボルとすると、シンボルの位置情報が３ビットであるため、１１×３＝３３ビットのアドレスに応じたＲＯＭが必要になり、ＲＯＭの記憶容量が膨大になり、装置が大型化し、コストも高いという問題がある。

【００１４】本発明は、π／４シフトＱＰＳＫを用いて、ナイキストフィルタを通した後の波形を予め計算してその結果をメモリに格納する送信装置において、メモリ容量を少なくすることを目的とする。

【００１５】

【課題を解決するための手段】本発明は、π／４シフトＱＰＳＫの送信装置において、複素平面上で座標中心から等距離に位置し、隣り合うシンボルの互いの位相差がπ／２である４個のシンボルを定めると共に、送信すべきデータである２値化信号列を２ビットづつ分け、この２ビットで決まる４通りのデータを前記４個のシンボルに夫々割り当てて、当該２ビットのデータに対応するシ

ンボルの位置情報をディジタル信号として出力する信号処理部と、この信号処理部からのシンボルの位置情報が所定のタイミングで順次取り込まれ、注目しているシンボル及びその前後のシンボルの位置情報の配列がシフトしながら記憶されるシフトレジスタと、シンボルが推移するときの所定の特性のフィルタを通した後の予め計算された波形データの同相成分及び直交成分がシンボルの推移と対応づけて格納されると共に、前記シフトレジスタから出力される、当該シフトレジスタに記憶されたシンボルの位置情報の配列に対応するディジタル信号をアドレスとして、前記波形データの同相成分及び直交成分が読み出されるメモリと、復調用の搬送波の周波数をｆｃ、シンボルレートをｆｓとすると、周波数がｆｃ±ｆｓ／８であって、互いにπ／２位相がずれている第１及び第２の搬送波を出力する搬送波出力部と、前記メモリから読み出される同相成分及び直交成分に応じたアナログ信号により前記第１及び第２の搬送波を夫々振幅変調する第１及び第２の振幅変調部と、これら第１及び第２の振幅変調部からの変調出力を合成して合成波を出力する合成部と、を備えたことを特徴とするものである。

【００１６】ここでシフトレジスタに記憶される、注目しているシンボル及びその前後のシンボルの位置情報の配列とは、あるシンボルＰに対応する波形を出力しようとする場合、このシンボルに至るまでに推移してきた過去のシンボル及びシンボルＰを通過した後の将来のシンボルを含めたシンボルの位置情報の推移の並びという意味である。

【００１７】

【発明の実施の形態】本発明の実施の形態の送信装置の構成を説明する前に、この実施の形態の概要について図１を用いて説明する。複素平面においてＡ１～Ａ４及びＢ１～Ｂ４で示す８個のシンボル（信号点）は、隣り合うもの同士の位相が４５度ずつずれており、従来のπ／４シフトＱＰＳＫであれば、Ａ１～Ａ４のグループとＢ１～Ｂ４のグループとがシンボルレートに応じたタイミングで交互にデータ割り当て（マッピング）の対象になる。

【００１８】この実施の形態は、π／４シフトＱＰＳＫが見かけ上８個のシンボルを必要とするので８個の位置情報を必要としていたところを、４相ＱＰＳＫで用いる４個のシンボルの位置情報だけを用いながらπ／４シフトＱＰＳＫの通信方式を実現し、これによってＲＯＭのアドレスの数を減らし、メモリ容量の増大を抑えようとしている。

【００１９】今データが（１０）から（１１）に変わる場合、従来のπ／４シフトＱＰＳＫであれば図１において搬送波が反時計方向に回っているとすると、データに対応するシンボルは、Ａ４からＢ２に推移するが、本例ではＡ４からＡ１に見かけ上推移させる、つまりデータ（１１）をＡ１としてマッピングし、Ａ１の位置情報をシフトレジスタに出力する。しかしこのままでは従来の４相ＱＰＳＫと同じであるので、搬送波をπ／４分だけ早めるようにする。搬送波を早めるとは、受信装置で復調するときの搬送波に対して早めるという意味であり、復調時の搬送波の周波数をｆｃ、シンボルレートをｆｓとすると、送信装置で用いる搬送波周波数は、ｆｃにｆｓ／８を加えた値（ｆｃ＋ｆｓ／８）となる。

【００２０】Ａ４からＡ１への推移は１シンボル分の推移の時間（１／ｆｓ）だけかかるので、この時間に合わせて上述の如くｆｃを早めることにより、Ａ４からＢ２に推移して通信が行われたことと同じになる。このシンボルの推移に対応する、ＲＯＭ内に格納される波形データはＡ１、Ａ４間の補間データである。

【００２１】この例ではデータが複素平面を左回りに移動していくものとして説明しているが、右回りの場合には、Ａ４の次にＡ１を割り当てて、搬送波をπ／４分だけ遅らせることによりＡ４からＢ１に推移して通信が行われたことと同じになる。即ちこの場合には送信装置で用いる搬送波の周波数はｆｃ－ｆｓ／８となる。このように本発明は、４相ＱＰＳＫと同様にシンボルを割り当て、搬送波周波数をｆｃに対してｆｓ／８だけずらした点に特徴がある。

【００２２】次にこのような手法を実現するための回路構成について図２を参照しながら説明する。図１０と同一部分については同一の符号を示してある。送信すべきデータに応じたシリアル信号はシリアル／パラレル変換器３により２ビットのパラレル信号に変換され、このパラレル信号に応じてマッピング回路３２からシンボルの位置情報が出力される。ここで行われるマッピング（パラレル信号をシンボルに割り当ててその位置情報を出力すること）は４相ＱＰＳＫと同様であるため、π／４シフトＱＰＳＫで行っていた差動マッピングは行っていない。

【００２３】マッピング回路３２からは、割り当てられたシンボルの位置情報が出力されるが、この位置情報はシンボルが４個であるため２ビットの信号であり、第１及び第２のシフトレジスタ６Ａ、６Ｂにはこの２ビットの位置情報が順次に取り込まれ、例えば送信しようとするシンボル（注目するシンボル）の前後５個ずつのシンボルを含む１１個のシンボルの位置情報が記憶される。

【００２４】第１及び第２のＲＯＭ７Ａ、７Ｂ内には、従来技術の項で述べたように送信しようとするシンボルについて、その前後５個ずつのシンボルを含む１１個のシンボルの推移に対応するナイキストフィルタのレスポンス波形データが格納されている。この波形データは、例えば送信しようとするシフトレジスタとその一つ前のシンボルとを結ぶデータの移動軌跡を特定する例えば８個の予め計算された補間データであって、図９に示すＲＯＭ２Ａ、２Ｂ内のデータと同じであり、第１のＲＯＭ７Ａ内にはＩ成分のデータが、また第２のＲＯＭ７Ｂ内

にはQ成分のデータが夫々格納されている。ただし図１０におけるシフトレジスタ１Ａ（１Ｂ）からのアドレス線の数は３×１１であったが、本例ではシンボルの位置情報が２ビットで特定されるのでシフトレジスタ６Ａ（６Ｂ）からのアドレス線の数は２×１１であり、ＲＯＭ７Ａ（７Ｂ）内のデータのアドレスのビット数は２×１１となる。

【００２５】シフトレジスタ６Ａ、６Ｂでは、クロック発生器５０からのクロックにより最新のシンボルの位置情報が取り込まれると共に最も古いシンボルの位置情報が捨てられ、１１個のシンボルの位置情報の配列をアドレスとしてＲＯＭ７Ａ、７Ｂから波形データのＩ成分及びQ成分が夫々読み出される。前記クロックはシンボルレートｆｓを規定するものであり、クロックのパルス間隔は1／ｆｓ秒である。ＲＯＭ7Ａ（７Ｂ）にアドレスが与えられるとオーバサンプリングクロックにより例えば８個の補間データが順次読み出され、Ｄ／Ａ変換器４１Ａ（４１Ｂ）及びローパスフィルタ４２Ａ（４２Ｂ）を通って振幅変調器５Ａ（５Ｂ）に入力される。

【００２６】一方発振器５１から出力される搬送波はフェーズロックループ（ＰＬＬ）回路５４によりｆｓ／４だけ早められる。つまりｆｃ＋ｆｓ／４の周波数とされる。なおこのｆｃは既述の通り送信のキャリア周波数であり、受信装置で復調されるときの周波数でもある。第１及び第２の振幅変調器５Ａ、５Ｂにはｃｏｓ｛２π（ｆｃ＋ｆｓ／８）ｔ｝及びｓｉｎ｛２π（ｆｃ＋ｆｓ／８｝の搬送波が入力され、ローパスフィルタ４２Ａ、４２Ｂから出力されるＩ成分及びQ成分によって夫々変調され、その変調出力が合成部５３で合成される。この場合にはシンボルは図１において左回りであり、受信装置側のメモリでシンボルの位置座標とシンボルに割り当てられるデータとの対応関係を左回りとなるようにずらしている。

【００２７】ここで従来技術の項で一例として挙げた図７のシンボルの推移を本例にあてはめてみると、図３に示すようになる。即ちデータが（１０）→（０１）→（１１）→（００）と変化すると、従来の送信装置では点線に示すようにＡ４→Ｂ３→Ａ２→Ｂ１とマッピングされるが、本例ではマッピング回路３２で割り当てられるシンボルは鎖線で示すようにＡ４→Ａ２→Ａ２→Ａ４となる。受信側では従来のπ／４シフトＱＰＳＫの受信装置をそのまま用いることにより、（１０）→（０１）→（１１）→（００）のデータが復調される。

【００２８】以上のように本実施の形態によれば、π／４シフトＱＰＳＫによる通信を実現することができ、しかも４つのシンボルでデータを送信しているのでシンボルの位置情報が２ビットとなり、シフトレジスタに記憶するシンボルの数を上述の如く１１個とすればＲＯＭ７Ａ、７Ｂに取り込まれるアドレスは１１×２ビットとなる。従って８つのシンボルでデータを送信する場合に比べてアドレスのビット数が１つ減るので、ＲＯＭ７Ａ、７Ｂに対する必要なメモリ容量は半分となる。

【００２９】

【発明の効果】本発明によれば、π／４シフトＱＰＳＫを用いて、ナイキストフィルタを通した後の波形を予め計算してその結果をメモリに格納する送信装置において、メモリ容量を少なくすることができる。

【図面の簡単な説明】

【図１】本発明の実施の形態の動作を複素平面上で概念的に説明する説明図である。

【図２】本発明の実施の形態の回路構成を示す構成図である。

【図３】本発明の実施の形態と従来の手法とにおいてマッピングの様子を比較して示す説明図である。

【図４】ＱＰＳＫのシンボルを示す説明図である。

【図５】π／４シフトＱＰＳＫのシンボルを示す説明図である。

【図６】ナイキストフィルタを通した後のレスポンス波形を示す波形図である。

【図７】従来のπ／４シフトＱＰＳＫを用いて行うマッピングの一例を示す説明図である。

【図８】シフトレジスタからアドレスが出てＲＯＭからデータが読み出される様子を示す説明図である。

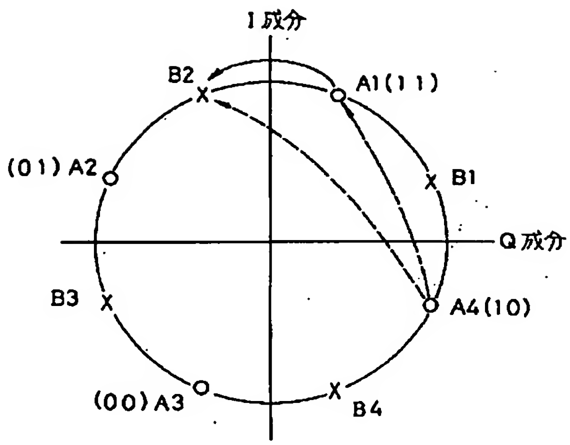
【図９】ＲＯＭ内に格納されているデータを概念的に示す説明図である。

【図１０】従来のπ／４シフトＱＰＳＫに用いられる送信装置の回路構成を示す構成図である。

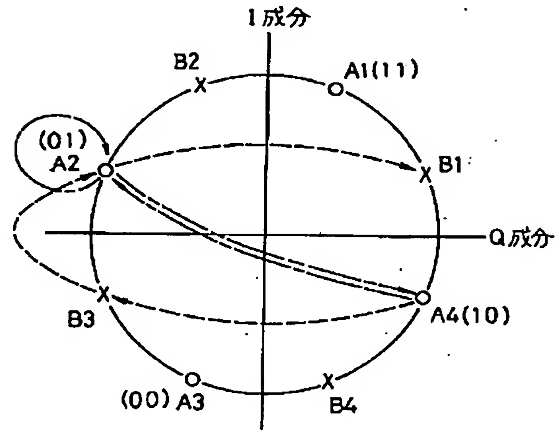
【符号の説明】

３	シリアル／パラレル変換器
３２	マッピング回路
４１Ａ、４１Ｂ	Ｄ／Ａ変換器
４２Ａ、４２Ｂ	ローパスフィルタ
５Ａ、５Ｂ	振幅変調器
５０	クロック発生器
５１	発振器
５２	移相器
５３	合成回路
５４	ＰＬＬ回路
６Ａ、６Ｂ	シフトレジスタ
７Ａ、７Ｂ	ＲＯＭ

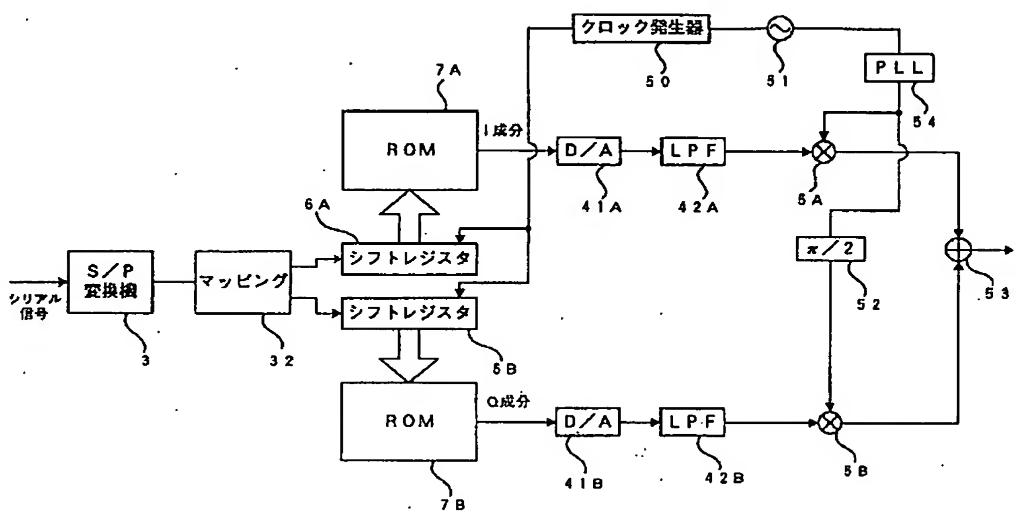
【図１】


I 成分
B2
A1(11)
(01) A2
B1
Q 成分
B3
A4(10)
(00) A3
B4

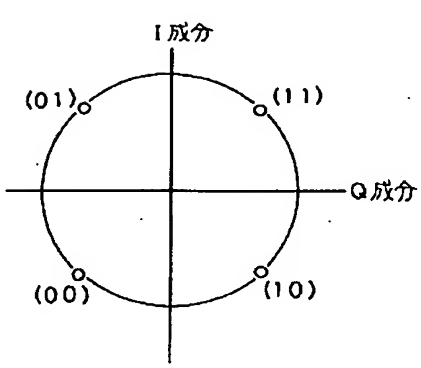
【図３】


I 成分
B2
A1(11)
(01)
A2
B1
Q 成分
B3
A4(10)
(00) A3
B4

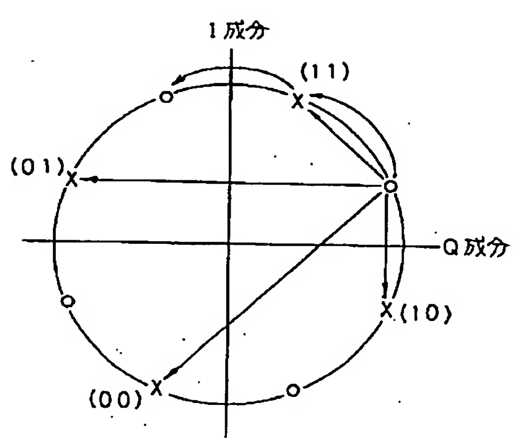
【図２】


クロック発生器
50
51
PLL
54
7A
ROM
I 成分
D/A
LPF
41A
42A
5A
6A
シフトレジスタ
π/2
52
53
シリアル信号
S/P
変換機
3
マッピング
32
シフトレジスタ
6B
ROM
Q成分
D/A
LPF
5B
41B
42B
7B

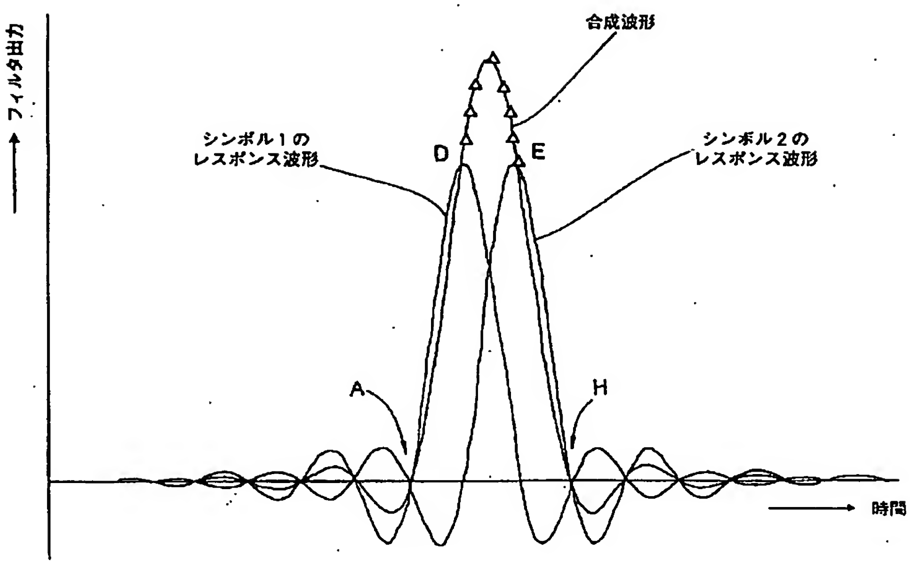
【図４】


I 成分
(01)
(11)
Q 成分
(00)
(10)

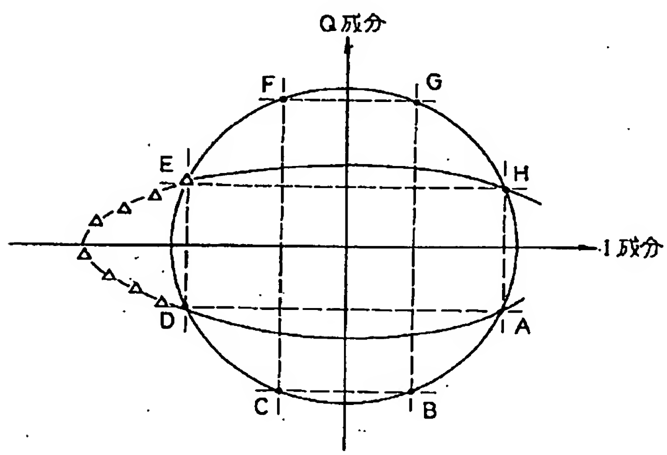
【図５】


I 成分
(11)
(01)
Q 成分
(10)
(00)

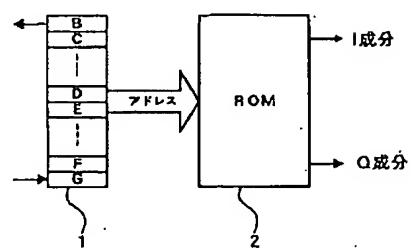
【図６】



【図７】



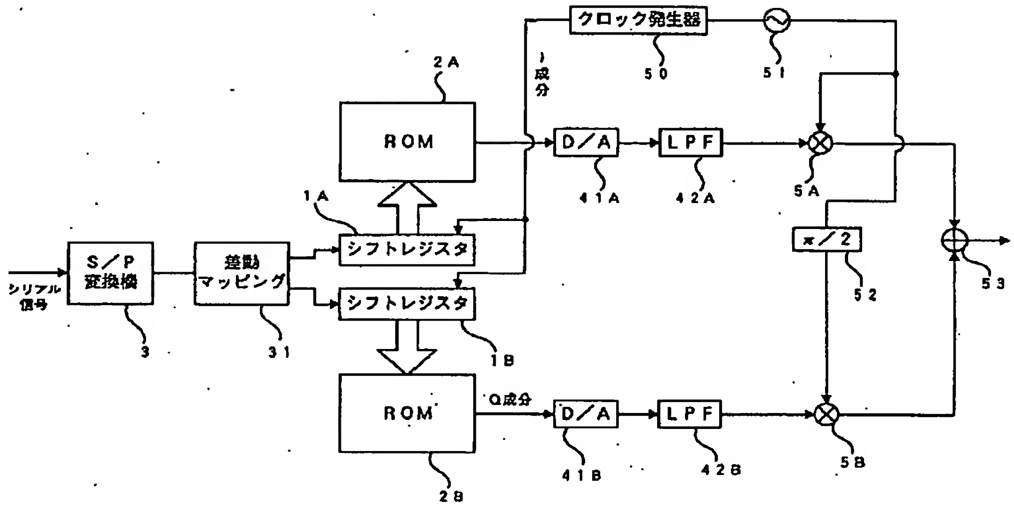
【図８】



【図９】

シンボルの配列(アドレス)	波形の軌跡データ
⋮	⋮
BCGADEHBEFG	1.　I(Q)成分データ
	2.　I(Q)成分データ
	3.　I(Q)成分データ
	⋮
	8.　I(Q)成分データ
⋮	⋮

【図１０】


クロック発生器
50
51
I成分
2A
ROM
D／A
LPF
41A
42A
5A
1A
シフトレジスタ
π／2
52
53
S／P
変換機
差動
マッピング
シフトレジスタ
シリアル
信号
3
31
1B
ROM
Q成分
D／A
LPF
5B
41B
42B
2B